

*Abstract of the Invention*

1 An optical device includes a stack of at least two different intersubband (ISB) optical  
 2 sub-devices in which the gain/loss profiles of the individual ISB sub-devices are mutually  
 3 adapted, or engineered, so as to generate a predetermined overall function for the combination.  
 4 We define this combination device as being *heterogeneous* since not all of the individual ISB  
 5 sub-devices are identical to one another. Illustratively, the parameters of each individual ISB  
 6 sub-device that might be subject to this engineering process include: the peak energy of the ISB  
 7 optical transitions (emission or absorption) associated with each RT region, the position of each  
 8 sub-device in the stack; the oscillator strengths of these ISB transitions; the energy bandwidth of  
 9 each transition; and the total length of the RT and I/R regions of each ISB sub-device. In one  
 10 embodiment, our approach may be used to engineer a gain profile that has peaks at a multiplicity  
 11 of different wavelengths, thus realizing a multi-wavelength ISB optical source in which the  
 12 applied electric field self-proportions itself so that each individual ISB sub-device experiences  
 13 the appropriate field strength for its particular design. Alternatively, the gain profile may be  
 14 engineered to be relatively flat over a predetermined wavelength range. In another embodiment,  
 15 our approach may be used to generate a function that compensates for a characteristic of another  
 16 device. For example, our heterogeneous ISB device may be engineered to have a gain profile  
 17 that compensates for the loss profile of another device. Alternatively, the gain/loss profile may  
 18 be engineered to produce a nonlinear refractive index profile in our device that compensates for  
 19 that of another device (e.g., an optical fiber).